Method for Making a Layered Paper or Board Web

The invention relates to a method for making a layered paper or board web, in which method thick stock delivered to a paper machine is diluted with tail water and the diluted stock is fractionated to produce two different stock fractions of which, the first stock fraction, containing on an average finer material than the second stock fraction, is conducted into the surface layer or layers of the paper or board web, and the second stock fraction, containing on an average coarser material than the first stock fraction, is conducted into the middle layer or layers of the paper or board web.

A stock feed system for a multi-layer headbox is disclosed in the US patent No. 5,746,889, in which different stock concepts are produced out of the same fresh stock to be fed into different layers of the multi-layer headbox. The stock feed system contains at least one screen for transferring long fibers out of the stock that is destined to form the surface layer of the paper into the stock that is destined to form a layer placed in the interior of the paper. The system may also contain another screen for transferring short fibers out of the stock that is destined to form the layer placed in the interior of the paper into the stock that is destined to form the surface layer of the paper.

Fractionating methods that apply centrifugal cleaning are disclosed in WO published applications Nos. 0 129 311 A1 and 0 222 947 A1, in which accept from the first centrifugal cleaning step is transferred into the surface layers of the web to be formed, and the accept from a second or lower step is transferred into the middle layers of the web to be formed. By fractionating the stock, lower fines contents and higher average fiber length can be achieved in the middle layers of the web than in the surface layers of the web. On the other hand, higher fines and filler contents can be achieved in the

surface layers of the web than in the middle layers, which, among other things, improves the printing properties of the paper.

The accept fibers separated during the fractionating of the stock are on an average shorter, thinner and more pliable, and the accept contains more fines and filler than the reject. For simplicity's sake, the accept from fractionation will be referred to as the fine stock fraction and the reject from fractionation will be referred to as the coarse stock fraction.

It is typical for fractionating that the consistency of the accept is decreased and the consistency of the reject is increased compared to the consistency of the feed. Because of this, the reject often has to be diluted before it can be conducted into the headbox of the paper machine. In WO 0 222 947, the rejects from the fractionating stages are diluted with tail water taken from a wire pit before they are transferred into the next stage. In WO 0 129 311, the same tail water is being used for diluting both the accept and the reject before they are fed into the different layers of the multi-layer headbox. When the coarse stock fraction intended for the middle layers of the web is diluted with "impure" tail water, i.e. containing plenty of fines and filler, at least some of the advantages obtained with fractionating are lost. Because of the tail water, the drainability of the reject can go down almost to the level of the accept and the filler content can go up to near the filler content of the accept.

The object of the invention is to provide an improved method for manufacturing a web from a stock by layering the different fractions thereof. Especially, the object is to maintain the different properties of the stock fractions produced by fractionating, whereupon the objectives set for the layering of the stock are easier to reach.

In order to obtain these and other objects that will become evident later, the method according to the invention is characterized by what is defined in the characterizing

part of claim 1.

When the coarse stock fraction is diluted with water that contains less solids originating from the stock than normal tail water, the different properties of the stock fractions used for different layers of the paper or board web can be maintained better than before, which improves the result of layering in paper or board manufacturing.

Tail water is a filtrate removed from the web being formed on the wire section, which water is collected into a wire pit or the like and which contains fines and filler originating from the paper stock. A major part of the solids contained in the primary tail water is returned into the process by using tail water for diluting the thick stock in the short circulation of the paper machine.

Water suitable for diluting the coarse stock fraction is characterized by the fact that the consistency of the water is substantially lower than the consistency of the tail water used for diluting the thick stock before fractionating. Preferably, the consistency of the diluting water is less than 60 % of the consistency of the primary tail water.

Examples of possible water fractions suitable for diluting the reject are cloudy and clear filtrate from the recovery of fibers, water coming from suction flatboxes, separately collected paper machine spray water, water coming from the press section and tail water fractioned by clarification or some other method. One option is to dilute tail water with a substantially cleaner water fraction such that the consistency of water used for diluting the coarse stock fraction is substantially lower than the original consistency of the tail water.

In the following, the invention will be described with reference to the examples in the appended figures, but the intention is not to limit the invention to these only.

Figure 1 shows a schematic view of manufacturing of layered paper using fractionating of the stock and a multi-layer headbox.

Figure 2 shows manufacture of a multi-layer web using fractionating of the stock and two different web-forming units.

According to figure 1, thick stock M is delivered into the paper machine via a wire pit 10, where it is diluted with tail water originating from the wire section. The diluted stock M_1 is conducted with a pump P_1 into a first centrifugal cleaning step 11 of a centrifugal cleaner equipment, where the stock is fractionated into two stock fractions A and B. Fractionating is performed so, that the first stock fraction will contain fibers that on an average are thinner, shorter and more pliable and also more fines and filler than the second stock fraction B. Because of this, the stock fractions are in the following referred to as the fine stock fraction A and the coarse stock fraction B.

The fine stock fraction A from fractionation is conducted as two component flows A_1 and A_2 through pumps P_{A1} and P_{A2} and machine screens 13_{A1} and 13_{A2} into two layers 14_{A1} and 14_{A2} of a multi-layer headbox 15 that are used to form the top and bottom layers of the manufactured paper or board web.

The coarse stock fraction B from fractionation is diluted and the diluted stock flow B_1 is conducted through a pump P_2 into a second centrifugal cleaning step 12 of the centrifugal cleaner equipment, where impurities are extracted from the stock. The accept B_2 from the centrifugal cleaning step 12 is conducted through a pump P_B and a machine screen 13_B into a layer 14_B of the multi-layer headbox that is used for forming the middle layer of the paper and board web.

As the fractionating increases the consistency of the coarse stock fraction B, the stock B must be diluted before conducting it into the headbox 15. Conventionally, tail

water D_1 taken from the wire pit 10, containing substantial amount of fibers, fines and filler, is used for dilution. In the solution according to the invention, a water flow D_0, whose consistency is lower than the consistency of the tail water D_1 taken from the wire pit 10, is conducted into diluting the coarse stock fraction B. This water can, for example, be taken from fiber recovery screen, spray water recovery or from suction flatboxes. Also water from the wire pit 10 can be used as dilution water, provided that enough solids have been extracted from it in a separate process stage (not shown). Dilution water, which is substantially cleaner than the tail water, can also be obtained by diluting water from the wire pit with a cleaner water fraction.

Figure 2 illustrates another solution according to the invention. There, the diluted stock M_1 is fractioned in the first centrifugal cleaning step 11 of the centrifugal cleaner equipment into two stock fractions A and B. The fine stock fraction A from fractionation is conducted into a headbox 16, which feeds the stock on a fourdrinier wire 18 for forming a first web W_1. The coarse stock fraction B from fractionation is diluted with a water flow D_0, whose consistency is lower than that of the tail water D_1 from the wire pit 10, and it is conducted into a second centrifugal cleaning step 12 of the centrifugal cleaner equipment. The cleaned stock B_2 is conducted through a pump P_B and a machine screen 13_B into a headbox 17, which feeds the stock on a second fourdrinier wire 19 for forming a second web W_2. The second web W_2 is carried by the wire 19 on top of the first web W_1 on the wire 18 and the webs W_1 and W_2 are joined together to form a two-layered board web.

When manufacturing multi-layer web, there naturally can be more than two separate web forming units and the web forming units may comprise besides a fourdrinier wire also a gap former.

Instead of the above-described centrifugal cleaning device, fractionation can also be carried out in a manner known per se by using pressure screens. By adapting the

fractionating techniques and the reject ratio, different types of properties can be obtained for the different layers of the web. There can naturally be more than one fractionating stage.

In the following the patent claims will be given, and the details of the invention may show variation within the scope of the inventive idea defined in said claims and differ from the details given above for the sake of example only.